ON THE VERTICAL DISTRIBUTION OF ANIMAL PLANKTON IN THE SEA OF JAPAN OFF SAN'IN-DISTRICT IN SUMMER OF 1952

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With 4 Text-figures and 2 Tables

Thirteen vertical hauls of plankton in daytime from the surface to the depth of nearly 500 m. were made at four stations 20 or 30 miles off San'in

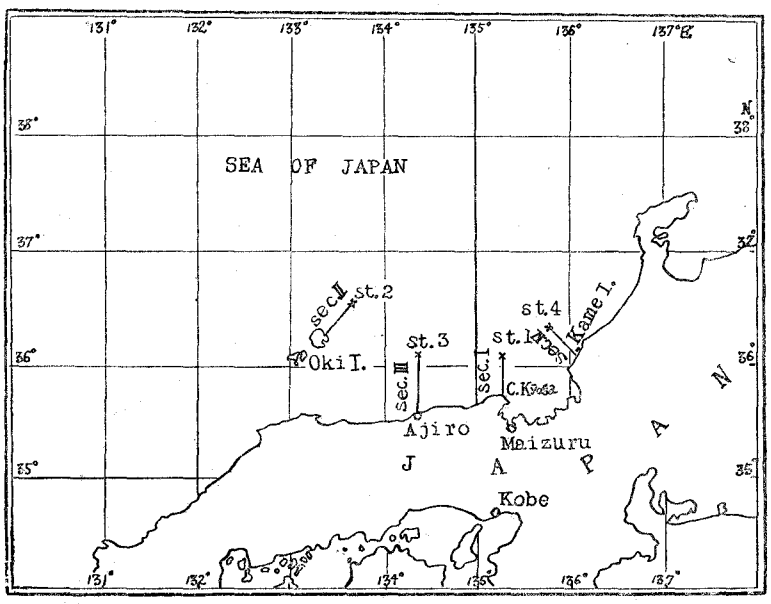


Fig. 1. Map showing the stations.

district in the Sea of Japan in the summer of 1952 (Fig. 1). A KITAHARA's quantitative net (20 cm. in mouth diameter and stretched with bolting silk No. 13—129 meshes per inch) was towed vertically from 50 m. to the surface at

each station, and at the same time a large closing net (40 cm. in diameter, 2 m. in length and stretched with bolting silk No. 5—66 meshes per inch) was towed vertically in step method in layers deeper than 50 m.. All the data obtained during the observations are given in Table 2 at the end of this article.

As we have not yet full knowledge about the distribution of animal plankton in deeper water of the area mentioned above, the author wishes to give herein some brief notes on animal plankton found in hauls and also on the relation between the vertical distribution of the animals and the hydrographical condition.

The author is indebted much to Dr. K. HISHIDA and Mr. I. NAKAYAMA of Maizuru Marine Observatory and to the crew of the "Kuroshio Maru" throughout the work to whom he wishes to express here his hearty thanks. He is also very grateful to Dr. T. TOKIOKA for his kind advices and generous encouragement given during the work.

Observations

I. Qualitative analysis of animal plankton

Seventy-five of 125 species of animal plankton identified during the observations, are occupied by copepods including some larval stages. The rest consists of 12 species of Chaetognatha and 38 species belonging to other animal groups. In the following, brief notes are given on some important species in deeper waters.

Copepoda:

1) *Calanus cristatus*: Totally 34 immature females were collected during the work. Some adults are previously reported by TANAKA (1938) from the deep layer under 500 m. in Sagami Bay and by NAKAI (1942) from the deep layer (1000–2000 m.) of Japan Sea.

2) *Calanus plumchrus*: The author already reported many immature females from the deep water of this area in 1951. A few mature females and a number of male were found during the present work.

3) *Eucalanus giesbrechti*: Seven males, together with some females, were found in the collection, although no male was found in last year.

4) *Gaetanus armiger*: Only one female was found in a haul from the deep layer at St. 8.

5) *Bradyidius armatus*: Twenty females were found in hauls from deeper layers.

6) *Euchaeta japonica*: Plenty of immature individuals and a few adult males and females were collected from deep layers under 250 m..

Pteropoda:

7) *Clione limacina*: This pteropod was found in a considerable number from the deeper layer at each station. The largest specimen reaches 5 mm. in length.

8) *Limacina helicina*: Distributed as in last year, but not so much.

Coelenterata:

9) *Aglantha digitale*: Caught from the layer deeper than 100 m..

10) A species of Agalmidae: Probably a few individuals were found only in middle layers. As they were found in fragments such as nectophores, bractus and other parts, it was difficult to identify the species or to count individuals accurately.

Chaetognatha:

11) *Sagitta elegans*: This form was found in a considerable number in deeper layers at each station.

The species mentioned above belong to cold water forms or at least to deep water forms.

As listed in Table 1, the main components of zooplankton at each station and in each layer were copepods which occupy 85–95% of zooplankton except at St. 4. In the surface layer of St. 4, copepods decrease to 49.6% of zooplankton, on account of the occurrence of *Tintinnus* sp. in abundance (29.8%). The composition of copepods varies according to depth as will be mentioned in detail in the following paragraph.

The next commonest animals are tunicates in upper layers and crustaceans, excluding copepods, in deeper layers. In every sample from middle layers, fragments of an Agalmid form occurred abundantly.

II. Vertical distribution of animal plankton

During the present observation, the following 7 species were found only in the water shallower than 50 m.; *Acrocalanus gracilis*, *Labidocera japonica* and *Microsetella norvegica* of Copepoda, *Penilia schmackeri* of Phyllopoda, *Creseis acicula* of Pteropoda, *Sagitta regularis* and *S. neglecta* of Chaetognatha.

All species mentioned above belong to warm water forms.

At every station samplings were made at about the noon. These animals might be distributed even in deeper layers by the vertical dispersion, if the circumstances of the deep water permit them to survive. Thus, they are considered as typical species in the surface layer of warm Tsushima Current.

A few of the species found in samples from middle layers (100 m.–250 m.) are regarded as characteristic ones to the layers. They are *Clenocalanus*

Table 1. Composition of Zooplankton. (% to the whole zooplankton)

Station	St. 1			St. 2				St. 3			St. 4			
Lat. (N) Long. (E)	36-06.5 135-14.0			36-32.0 133-39.0				36-05.2 134-17.8			36-31.5 135-41.5			
Date (1952)	July 3			July 19				July 23			Aug. 9			
Time	11,45-12,45			11,20-13,00				12,35-13,40			12,50-13,45			
	No. 1	No. 2	No. 3	No. 1	No. 2	No. 3	No. 4	No. 1	No. 2	No. 3	No. 1	No. 2	No. 3	No. 4*
Hauled Distance(M) (Angle) Hauled Depth (M)	50-0 (30°) 43-0	210-55 (38°) 166-43	350-190 (40°) 268-146	50-0 (15°) 48-0	100-50 (15°) 97-48	250-90 (16°) 240-87	550-250 (26°) 494-225	50-0 (9°) 49-0	210-60 (16°) 201-58	500-206 (4°) 500-206	50-0 (12°) 49-0	200-50 (11°) 196-49	500-0 (16°) 491-0	(500-200) (491-196)
Copepoda	90.6	95.4	90.8	86.1	93.0	91.2	84.9	82.4	90.5	85.6	49.6	92.2	88.6	90.8
Crustacea	—	2.7	2.9	1.2	0.4	4.1	12.6	0.4	2.0	12.3	0.6	1.7	5.5	6.6
Pteropoda	—	0.3	0.9	0.3	—	—	1.1	0.1	0.3	0.8	1.5	—	0.2	0.3
Coelenterata	—	0.0	0.6	—	—	0.2	0.4	—	0.0	0.6	—	0.0	0.1	0.2
Chaetognatha	0.0	0.0	0.5	2.2	0.1	0.6	0.4	0.9	0.6	0.1	3.4	0.7	1.5	0.3
Tunicata	8.7	1.3	0.9	6.2	0.8	0.7	—	14.1	4.7	0.1	15.1	5.0	2.9	0.2
Protozoa	0.5	—	2.2	2.6	1.3	1.9	0.2	0.8	0.8	—	29.8	0.2	0.8	1.3
Larva	0.2	0.3	1.2	1.4	4.4	1.3	0.4	1.3	1.1	0.5	—	0.2	0.4	0.3

* Estimated from the values of Nos. 2 and 3 at St. 4 hauled in step method.

longicornis of Copepoda, an Agalmid form of Coelenterata, *Sagitta serratodentata* of Chaetognatha and *Fritillaria borealis* of Tunicata.

The deeper water contained numerous species, of which 10 species were collected from the depth deeper than 200 m., while several other species were distributed widely in the range from 100 m. to 500 m.. Main species found regularly in deep water samples are listed next (Those with asterisk, show a widely distributed species):

Copepoda

1. *Calanus cristatus* ♀
2. *Calanus plumchrus** ♀, ♂
3. *Eucalanus giesbrechti** ♀, ♂
4. *Eucalanus attenuatus** ♀
5. *Pseudocalanus minutus** ♀, ♂
6. *Pseudocalanus gracilis* ♀
7. *Gaetanus armiger*
8. *Bradyidius armatus*
9. *Stephus* sp.
10. *Scorecithricella minor*
11. *Euchaeta japonica** ♀, ♂
12. *Metridia lucens** ♀, ♂
13. *Oncaea conifera**

Schizopoda

14. a species of Mysidacea*
15. a species of Euphausiacea

Pteropoda

16. *Limacina helicina**
17. *Clione limacina*

Coelenterata

18. *Aglantha digitale**

Chaetognatha

19. *Sagitta elegans**

It is interesting that some of the species show different distribution between sexes. For instance, females of *Calanus plumchrus* are distributed more deeply than males, but the relation is quite inverse in *Metridia lucens*. Most of the other species in the above-mentioned list are distributed more widely or rather irregularly.

Figure 2 indicates the vertical distribution of 9 species at St. 2. These species showed each an interesting distribution. The author made this figure assuming the equality of the filtering coefficients of KITAHARA's vertical net and the largy closing net. The blackened area is proportional to the individual number of each species. The vertical distribution of the water temperature is given on the right hand in the figure.

It seems to be useful to give some brief notes on each of these 9 species in the following.

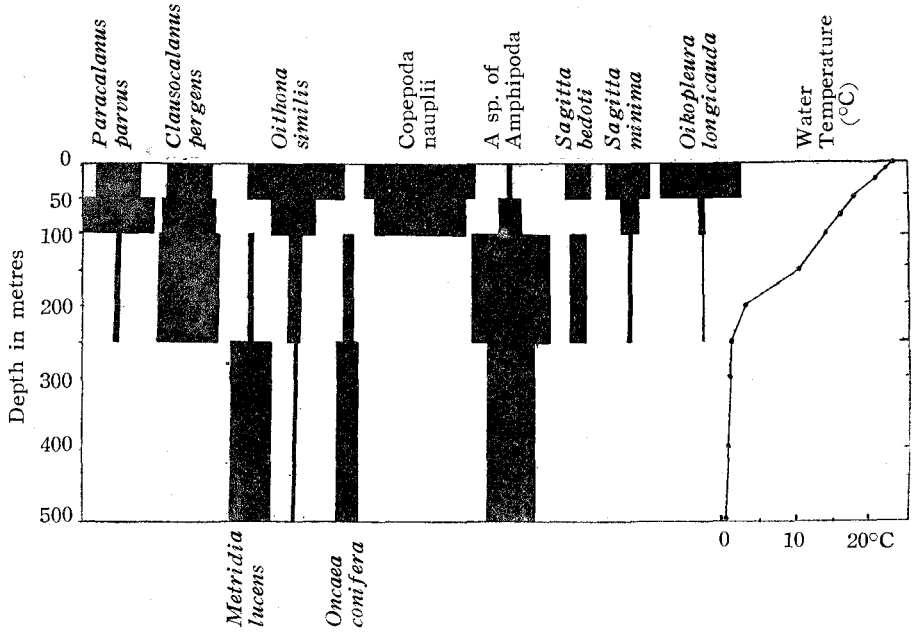
1) *Paracalanus parvus* is known to distribute in the surface layer. In the present data its densest population is found in the layer between 50 m. to 100 m.. This distribution seems to be too deep for the species, but it may be understood

reasonably if we notice the fact that the distribution of this species covers the wide range of the water temperature from 7-8°C to 25°C and that the sampling was made in daytime of midsummer. Similar distribution of this species is reported by MOTODA and ANRAKU (1952) in the study of Funka Bay.

2) *Clausocalanus pergens* was distributed uniformly from the surface to 250 m.. This distribution agrees well with the result obtained by MOTODA and ANRAKU (1951) in Ishikari Bay. This species seems to distribute in the water temperature from 7-8°C to 20°C.

3) *Metridia lucens* females were distributed in the layer deeper than 200 m., while males were distributed more widely. The data obtained at St. 1

Fig. 2. Vertical distribution of important animal planktons at St. 2.



shows the possibility that males were distributed in the water deeper than 150 m., where the temperature was below 10°C.

4) *Oithona similis* was found abundantly in the surface layer shallower 50 m., although the deepest limit of distribution reached 500 m.. *Oithona plumifera* showed the same distribution as in the previous species.

5) *Oncaea conifera* has been said to be a species usually found in a small quantity in the surface layer of Tsushima Current. The present observation, however, reveals that its range is wider and extends down to the layer deeper than 200 m. where the temperature is below 8°C.

6) Nauplii of copepods were distributed abundantly in the layer shallower than 100 m., but no individual was found in layers deeper than 100 m..

7) A species of Hyperiidae was widely distributed from the surface to 500 m., but mainly in the layer deeper than 100 m.. It may be noteworthy that all individuals found in surface layers were immature, while those found in deeper layers were mostly mature reaching beyond 10 mm. in length.

8) *Sagitta bedoti* was distributed as in the previous species; namely immature individuals were found in the layer shallower than 50 m. and adults in deeper layers from 100 m. to 250 m.. It was a curious phenomenon that no individual of this species was found in the middle layer from 50 m. to 100 m.. Such a manner of distribution was observed not only at St. 2, but also at other stations. As to the chaetognaths fauna in the surface layer of the studied area refer the paper of TOKIOKA (1951).

9) *Oikopleura longicauda* was concentrated in the layer shallower than 50 m., although a few individuals were found also in deeper layer. Taking the result obtained at St. 1 into consideration, this species may live largely in the layer shallower than 150 m., where the temperature is beyond 10°C.

III. Distribution of animal plankton in relation to some hydrographical conditions

a) Significance of the depth.

At first, we must take into consideration that in this area the cold water mass of the temperature below 1°C lies under the warm Tsushima Current. Consequently the range of the distribution of animal plankton in this area does not represent the range in the area where the water is considered of uniform charactor. *Clione limacina* and *Limacina helicina* of Pteropoda, *Sagitta elegans* of Chaetognatha and *Calanus plumchrus* of Copepoda are all known to show the maximum density in the surface layer in cold waters (KOKUBO, 1932; TOKIOKA, 1940; MOTODA & ANRAKU, 1951).

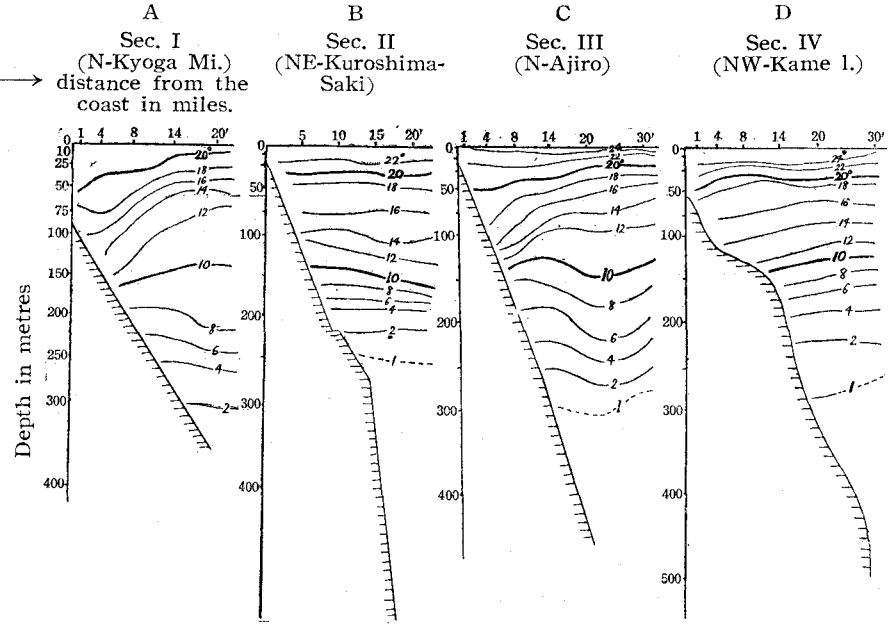
In this area, however, they are distributed in the layer deeper than 200 m. or 250 m., where the temperature is below 8°C. It is clear that the depth itself does not play any essential rôle limiting the vertical distribution of cold water animals in this area, although it may control effectively the vertical distribution of warm water animals especially living in the surface layer.

b) Effect of vertical migration.

All samples were hauled in midday, consequently the distribution of most copepods and other animals capable of violent movement may be considered to show the deeper limit to survive under the present circumstances. Next, the

upper limit of distribution of the cold water forms should be taken into account. In summer of 1951, several plankton samples were hauled in the same area at the following stations in night, namely from sunset to dawn: six stations off Kyôga-misaki on July 31st and August 1st, one station off Kasumi on August 2nd and four stations off Echizen-misaki on July 18th and 19th. A net was towed at each station vertically from 50 m. to the surface. I found only warm water forms in these hauls; cold water forms are therefore considered to be unable to migrate into the upper layer by the vertical movement during night. The details shall be shown in Maizuru Jour. Ocean., Vol. II, No. 1 (in press).

Fig. 3. Vertical distribution of water temperature.



c) Effect of the water temperature.

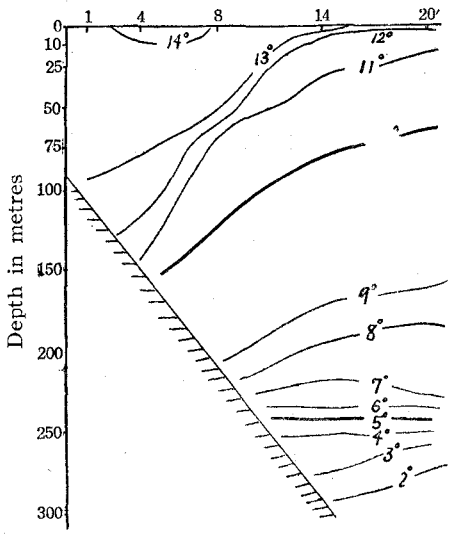
One of the important factors controlling the unusual distribution of animal plankton in this area is probably the water temperature. Vertical distributions of the water temperature at four sections each containing one of four stations are shown in Fig. 3 (A-D).

As shown clearly in these figures, the temperature was 12°C.-25°C. in layers shallower than 100 m., where many warm water forms were found. The temperature dropped with depth below the level of 100 m. and reached 1°C. at the depth of about 300 m..

Most of warm water forms are considered to be impossible to survive in

deep cold layers. Actually the distribution of warm water forms was limited to the layer shallower than 100–150 m.. Cold water forms have never been found in a considerable number in any sample hauled in the layer shallower than 50 m. in this area during these four years since 1949, except in the following one case. In samples hauled in midday of May 1st. 1952 in the shallow water off Kyôga-misaki, immatured females of *Calanus plumchrus* were found in a considerable number, namely 2 at St. 3, 119 at St. 4 and 181 at St. 5, 20 miles off the coast. *Psudocalanus minutus*, *Scorecithricella minor* and *Metridia lucens* were hauled at St. 4 and 5, where the isotherm of 11°C was raised to 50 m. layer as shown in Fig. 4. Such abnormal distribution of water temperature was not observed in this area even in winter (Maizuru Marine Observatory, 1952). Consulting the data mentioned above, the author wishes to propose provisionally that the upper limit of the distribution of cold water forms is situated approximately near the isotherm of 11°C. (Fig. 4).

Fig. 4. Vertical section of water temperature 20 miles north off Kyôga-misaki.
⟶ Distance from the coast in miles



Summary

Copepods occupied about 80% of the whole animal plankton in individual number and they were fairly distributed in response to the stratified water temperature. Some warm water forms were found in upper layers shallower than 50 m., where the temperature was over 18°C. Most of other warm water forms descended to the depth of 150 m., where the temperature was over 12°C. Many cold water forms were concentrated in deep layers under 200 m., where the temperature was below 8°C. The upper limit of the distribution of cold water forms was considered to be situated near the isotherm of 11°C. *Oithona similis* and *Oithona plumifera* were distributed throughout from the surface to the depth of about 500 m..

At any rate the vertical distribution of animal plankton in the area off San'in district is at the mercy of cold water mass lurking under the warm Tsushima Current.

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Table 2.

Numerals indicate the estimated total individual numbers calculated from the mean of countings on 3-6 slide materials (0.5 cc) of each sample. Those distinguished by parentheses are the total individual numbers actually counted. *..... see Table 1.

Individual number of the whole animal plankton			St. 1			St. 2				St. 3			St. 4			
			35,992	63,089	7,451	19,295	12,703	17,794	20,552	25,391	21,712	27,441	5,618	17,809	58,105	35,168
COPEPODA			No. 1	No. 2	No. 3	No. 1	No. 2	No. 3	No. 4	No. 1	No. 2	No. 3	No. 1	No. 2	No. 3	*No. 4
1. *Calanus cristatus* (immature)		♀	—	—	(1)	—	—	—	(8)	—	—	(15)	—	—	(10)	(10)
2. *Cal.*	*plumchrus*	♂	—	(2)	(88)	—	—	(8)	(293)	—	(1)	(446)	—	(7)	(310)	(303)
" "	"	♂	—	—	—	—	—	—	(27)	—	—	(59)	—	—	(41)	(41)
3. *Cal.*	*helgolandicus*	♀	—	114	—	(6)	+	535	100	(11)	(24)	125	—	(14)	333	319
" "	"	♂	—	—	—	—	(1)	—	—	—	(5)	—	—	(1)	—	—
4. *Cal.*	*tenuicornis*	♀	—	200	—	—	—	+	—	—	(7)	—	—	267	167	—
" "	"	♂	—	—	—	—	—	—	—	—	—	—	—	100	200	—
5. *Cal.*	*minor*	♀	—	—	—	—	(2)	—	—	—	—	—	—	—	(1)	—
6. *Cal.*	juv.		—	—	—	—	—	—	—	—	—	—	—	—	(3)	(3)
7. *Eucalanus*	*giesbrechti*	♀	—	—	(2)	—	—	—	(8)	—	—	(7)	—	—	(10)	(10)
" "	"	♂	—	—	—	—	—	(1)	(4)	—	—	(1)	—	—	(1)	(1)
8. *Eu.*	*attenuatus*	♀	—	—	(3)	—	—	(3)	(5)	—	—	—	—	—	(1)	(1)
9. *Eu.*	*crassus*	♀	—	—	—	—	—	—	—	—	(1)	(2)	—	(1)	—	—
10. *Eu.*	*mucronatus*	♀	—	—	—	—	(1)	—	—	—	—	—	—	—	—	—
11. *Rhincalanus*	*nastus*	♀	—	—	—	—	—	(2)	(1)	—	—	—	—	—	—	—
12. *Acrocalanus*	*gracilis*	♀	—	—	—	—	—	—	—	33	—	—	—	—	—	—
13. *Paracalanus*	*aculeatus*	♀	—	—	—	33	—	—	—	—	—	—	—	—	67	—
14. *Para.*	*parvus*		900	3,133	—	533	1,000	300	—	800	3,067	—	50	2,067	3,067	—
15. *Mecynocera*	*clausi*	♀	—	—	—	33	—	—	—	—	—	—	—	—	—	—
16. *Clausocalanus*	*arcuicornis*	♀	—	—	—	—	67	—	—	—	—	—	—	67	66	—
17. *C.*	*pergens*	♀	200	17,933	2,867	333	234	4,800	—	533	4,800	—	17	4,400	2,600	—
" "	"		267	1,533	—	—	167	167	—	433	700	—	—	500	—	—
18. *C.*	*furcatus*	♀	—	600	—	—	67	—	—	133	—	—	—	—	—	—
19. *Ctenocalanus*	*longicornis*	♀	—	—	—	—	33	—	—	—	67	—	—	—	—	—
20. *C.*	sp.		—	200	—	—	—	67	—	—	—	—	—	—	—	—
21. *Pseudocalanus minutus*		♀	—	—	100	—	—	133	50	—	—	933	—	—	267	267
" "	"	♂	—	—	—	—	—	—	25	—	—	—	—	—	—	—
22. *P.*	*gracilis*	♀	—	—	—	—	—	—	150	—	—	—	—	—	—	—
23. *P.*	sp.		—	200	133	—	—	—	925	—	33	—	—	—	—	—
24. *Gaetanus*	*armiger*	♀	—	—	—	—	—	—	—	—	—	(1)	—	—	—	—
" "	"	♂?	—	—	—	—	—	—	—	—	—	(3)	—	—	—	—
25. *G.*	sp.		—	—	—	—	—	—	—	—	—	—	—	—	(1)	(1)
26. *Bradyidius*	*armatus*	♀	—	—	—	—	—	—	(6)	—	—	(12)	—	—	(2)	(2)
" "	"	♂?	—	—	—	—	—	—	(29)	—	—	(20)	—	—	(2)	(2)

Table 2 (continued)

Individual number of the whole animal plankton		St. 1			St. 2				St. 3			St. 4			
		35,992	63,089	7,451	19,295	12,703	17,794	20,552	25,391	21,712	27,441	5,618	17,809	58,105	35,168
		No. 1	No. 2	No. 3	No. 1	No. 2	No. 3	No. 4	No. 1	No. 2	No. 3	No. 1	No. 2	No. 3	*No. 4
27. *Stephus*	sp. *a*	—	676	—	—	—	—	—	—	67	1,567	—	133	3,533	3,400
28. *Scorecithrix*	*danae* ♀	—	—	—	—	—	—	—	—	(1)	—	—	—	—	—
29. *Scorecithricella*	*minor* ♀	—	175	200	—	—	200	—	—	(1)	233	—	168	210	42
„ „	„ ♂	—	—	—	—	—	—	—	—	—	200	—	—	40	40
30. *Euchaeta*	*longicornis* ♀	—	—	—	—	—	(1)	—	—	—	—	—	—	(1)	—
31. *Eu.*	*plana* ♀	—	—	—	—	—	—	—	—	(1)	—	—	—	—	—
32. *Eu.*	*concinna* ♀	—	—	—	—	—	—	—	—	(1)	—	—	—	—	—
33. *Eu.*	*japonica* (mature) ♀	—	—	—	—	—	—	(3)	—	—	—	—	—	(1)	(1)
„ „	„ (mature) ♂	—	—	—	—	—	—	(3)	—	—	—	—	—	—	—
„ „	„ (immature) ♀	—	—	—	—	—	—	(29)	—	—	(14)	—	—	(14)	(14)
„ „	„ (immature) ♂	—	—	—	—	—	—	(30)	—	—	(21)	—	—	(16)	(16)
34. *Eu.*	*flava* ♀	—	—	—	—	—	—	—	—	—	—	—	(2)	(11)	(8)
„ *Eu.*	„ ♂	—	—	—	—	—	—	—	—	—	—	—	(1)	—	—
35. *Eu.*	sp.	—	—	—	—	—	(1)	—	—	—	—	—	—	—	—
36. *Eu.*	juv.	—	133	(6)	—	(2)	33	—	(2)	(4)	(5)	—	(6)	(5)	—
37. *Temora*	*stylifera* ♀	—	—	—	(1)	—	—	—	—	—	—	—	—	—	—
38. *T.*	*discaudata* ♀	—	—	—	—	(1)	—	—	—	(1)	—	(1)	—	—	—
39. *Pleuromamma*	*gracilis* ♀	—	—	—	—	—	+	—	—	—	—	—	—	(1)	(1)
40. *Metridia*	*lucens* ♀	—	(1)	—	—	—	—	1,000	—	—	1,625	—	—	1,300	1,300
41. *M.*	„ ♂	—	680	300	—	—	234	2,200	—	—	2,025	—	200	2,000	1,800
42. *Isochaeta*	sp.	—	—	—	—	—	+	—	—	—	—	—	—	—	—
43. *Lucicutia*	*flavicornis* ♀	—	—	—	—	—	—	—	—	(1)	—	—	—	(1)	(1)
44. *Pontellopsis*	*yamadae* ♂	—	—	—	—	—	—	—	—	(1)	—	—	—	—	—
45. *Labidocera*	*japonica*„ ♀	—	—	—	(1)	—	—	—	(1)	—	—	—	—	—	—
„ „	„ ♂	—	—	—	—	—	—	—	(2)	—	—	—	—	—	—
46. *Acartia*	*danae* ♀	—	—	—	(1)	—	—	—	(1)	—	—	—	—	(1)	—
47. *A.*	juv.	—	—	—	—	67	—	—	—	—	—	—	—	—	—
48. *Candacia*	*catula* ♂	—	—	—	—	—	—	—	(1)	—	—	—	—	—	—
49. *C.*	*truncata* ♂	—	—	—	—	(1)	—	—	—	—	—	—	—	—	—
50. *C.*	*bipinnata* ♀	—	—	—	—	—	(4)	—	—	(39)	—	—	(5)	—	—
„	„ ♂	—	—	—	—	—	(3)	—	—	(27)	—	—	(6)	(1)	—
51. „	sp.	—	—	—	—	—	(2)	—	—	—	—	—	—	—	—
52. *C.*	juv.	—	—	—	(2)	+	100	—	(1)	(2)	—	17	—	67	—
53. *Setella*	*gracilis*	—	—	+	—	—	67	—	—	—	33	—	—	66	66
54. *Euterpe*	*acutifrons*	—	—	—	33	34	—	—	33	—	—	—	—	—	—
55. *Clytemnestra*	*rostrata*	—	+	—	—	—	—	—	—	67	—	—	—	—	—
56. *Microsetella*	*rosea*	33	+	—	—	—	—	—	—	—	—	—	—	—	—
57. *M.*	*norvegica*	67	133	—	967	+	—	—	800	33	—	500	200	—	—
58. *Oithona*	*plumifera*	67	1,060	933	200	+	1,233	1,550	33	533	1,833	—	275	733	458

Table 2 (continued)

Individual number of the whole animal plankton			St. 1			St .2				St. 3			St. 4			
			35,992	63,089	7,451	19,295	12,703	17,794	20,552	25,391	21,712	27,441	5,618	17,809	58,105	35,168
			No. 1	No. 2	No. 3	No. 1	No. 2	No. 3	No. 4	No. 1	No. 2	No. 3	No. 1	No. 2	No. 3	*No. 4
59. *Oithona*	*similis*		8,550	2,000	1,100	3,433	1,433	4,200	1,550	9,400	3,767	2,533	667	2,067	11,533	6,598
60. *O.*	juv.		1,850	—	—	667	366	—	—	733	—	—	50	—	—	—
61. *Oncaea*	*conifera*		—	67	—	—	—	333	1,630	—	67	1,767	—	—	1,100	1,100
62. *On.*	*venusta*		—	167	—	267	833	33	—	133	833	—	33	1,033	667	—
63. *On.*	*media*		100	—	—	1,700	+	—	—	967	133	—	117	300	3,867	3,100
64. *On.*	sp.		33	—	—	—	—	100	25	—	—	—	—	—	—	—
65. *On.*	juv.		33	—	—	—	—	—	—	—	—	—	—	—	—	—
66. *Corycaeus*	*flaccus*	♂	—	—	—	—	—	—	—	(1)	—	—	—	—	67	—
67. *C.*	*trukicus*	♂	—	—	—	—	—	—	—	33	—	—	—	—	—	—
68. *C.*	*agilis*	♀	—	—	—	(1)	—	—	—	—	—	—	—	—	100	—
69. *C.*	sp.		—	—	—	100	133	+	—	—	—	—	—	33	—	—
70. *C.*	juv.		—	—	—	33	+	—	—	—	—	—	—	—	—	—
71. *Podopleura*	sp.		—	—	133	—	—	—	—	—	—	66	—	—	—	—
72. A sp. of Copepoda			—	—	—	—	—	—	—	—	—	50	—	—	—	—
73. other Copepods			—	—	—	—	—	—	—	—	—	23	—	—	—	—
74. Cope.	nauplii		13,650	67	—	3,967	3,233	—	—	3,100	1,567	—	1,017	67	200	—
75. Cope.	juv.		6,850	31,130	900	4,300	4,133	3,667	7,800	3,733	3,800	9,867	317	4,500	18,800	13,032
CRUSTACEA VARIA																
76. *Evadue*	*tergestina*		—	—	—	—	33	—	—	33	—	—	33	—	533	—
77. *Penilia*	*schmackeri*		—	—	—	233	—	—	—	67	—	—	—	—	—	—
78. *Conchoecia*	sp.		—	—	—	—	—	67	1,700	—	—	2,700	—	—	1,867	1,867
79. Mysidacean			—	(1)	—	—	—	—	(7)	—	(1)	(3)	—	—	(4)	(4)
80. Euphausiaceans sp.			—	—	(7)	—	—	—	(109)	—	—	(138)	—	—	(82)	(82)
81. A sp. of Hyperiid			—	1,700	(208)	(1)	(15)	667	743	—	433	527	—	300	686	386
82. other Hyperiids			—	—	—	—	—	—	(39)	—	—	(4)	—	(4)	(11)	(7)
83. *Lucifer*	*raynaudii*		—	—	—	—	—	—	—	—	—	—	—	—	(2)	—
PTEROPODA																
84. *Creseis*	*acicula*		—	—	—	67	—	—	—	35	—	—	84	—	—	—
85. *Clione*	*limacina*		—	—	(33)	—	—	—	149	—	—	225	—	—	(89)	(89)
86. *Limacina*	*helicina*		—	186	33	—	—	—	75	—	67	—	—	—	—	—
COELENTERATA																
87. *Aglantha*	*digitale*		—	—	(2)	—	—	(30)	(76)	—	—	(150)	—	—	(72)	(72)
88. Agalmidae	sp.		—	+	—	—	—	+	—	—	+	—	—	+	—	—
89. Trachymedusae sp.			—	(9)	(37)	—	—	—	—	—	—	—	—	—	—	—
90. *Muggiaea*	sp.		—	—	(1)	—	—	—	(7)	—	—	(7)	—	—	—	—
91. *M.*	spp.		—	—	(3)	—	—	—	—	—	—	—	—	—	—	—
92. Hydromedusae			—	—	—	—	—	—	—	33	—	—	—	(1)	—	—

Table 2 (continued)

Individual number of the whole animal plankton	St. 1			St. 2				St. 3			St. 4			
	35,992	63,089	7,451	19,295	12,703	17,794	20,552	25,391	21,712	27,441	5,618	17,809	58,105	35,168
CHAETOGNATHA	No. 1	No. 2	No. 3	No. 1	No. 2	No. 3	No. 4	No. 1	No. 2	No. 3	No. 1	No. 2	No. 3	*No. 4
93. *Sagitta elegans*	—	—	(30)	—	—	(6)	(71)	—	(1)	(35)	—	(1)	(87)	(86)
94. *S. enflata*	—	—	—	(3)	—	—	—	(2)	(2)	—	—	—	—	—
95. *S. bedoti*	(1)	(5)	(9)	(9)	—	(64)	—	(9)	(83)	—	(5)	(51)	(63)	—
96. *S. neglecta*	(1)	—	—	—	—	—	—	(1)	—	—	—	—	—	—
97. *S. minima*	(6)	(11)	—	(30)	(13)	(34)	—	(24)	(38)	—	(34)	(66)	(222)	—
98. *S. regularis*	—	—	—	(1)	—	—	—	—	—	—	—	—	—	—
99. *S. serratodentata*	—	—	—	—	—	—	—	—	(3)	—	—	—	—	—
100. *S. pseudoserratodentata*	—	—	—	—	—	—	—	—	(1)	—	—	—	—	—
101. *S.* sp.	—	—	—	—	—	—	—	—	—	—	—	—	(3)	(3)
102. *S.* juv.	—	—	—	373	—	—	—	205	—	—	150	—	500	—
103. *Pterosagitta draco*	—	—	(1)	—	—	—	—	—	—	—	—	—	—	—
104. *Krohnitta pacifica*	—	—	—	—	—	—	—	(1)	—	—	—	—	—	—
TUNICATA														
105. *Oikopleura longicauda*	2,950	780	67	1,100	100	100	—	3,033	1,033	—	450	900	1,400	—
106. *O. fusiformis*	—	40	—	33	—	—	—	233	—	—	84	—	133	—
107. *O.* sp.	—	—	—	—	—	—	—	—	—	33	317	—	—	—
108. *O.* juv.	167	—	—	67	—	—	—	300	—	—	—	—	—	—
109. *Fritillaria borealis*	—	—	—	—	—	33	—	—	—	—	—	—	67	67
110. *Doliolum nationalis*	—	—	—	—	—	—	—	—	—	—	50	—	66	—
PROTOZOA														
111. *Globigerina bulloides*	33	—	—	67	67	—	—	33	33	—	—	—	—	—
112. Foraminiferans	—	—	167	—	—	333	50	—	—	—	—	—	467	467
113. *Acanthometron pellucida*	—	—	—	267	—	—	—	33	—	—	—	33	—	—
114. Radiolarians	67	—	—	133	—	—	—	133	100	—	—	—	—	—
115. *Tintinnus* sp.	—	—	—	33	34	—	—	—	—	—	1,625	—	—	—
116. *Codonellopsis* sp.	—	—	—	—	—	—	—	—	—	—	33	—	—	—
117. *Rhabdonella* sp.	100	—	—	—	67	—	—	—	33	—	—	—	—	—
118. *Amphorella* sp.	—	—	—	—	—	—	—	—	—	—	17	—	—	—
LARVAL PLANKTON														
119. Balanus nauplius	—	—	—	—	133	—	—	—	33	—	—	—	—	—
120. Gastropoda velliger	67	—	—	—	300	167	75	100	133	—	—	33	133	100
121. Lamellibranchia velliger	—	—	—	167	—	—	—	133	67	33	—	—	66	—
122. Megalopa larva	—	—	(1)	—	—	—	—	—	—	—	—	—	(1)	(1)
123. Pluteus larva	—	133	50	100	100	—	—	—	—	—	—	—	—	—
124. Polychaeta larva	—	—	—	—	33	33	—	100	—	—	—	—	67	—
125. Fish eggs	—	20	(36)	—	—	33	+	—	—	100	—	—	—	—